Critical Digest.

ANATOMICAL, PHYSIOLOGICAL AND PATHOLOGICAL NOTES.

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The Functions of the Ganglion Cells of the Cervical Spinal Cord.

By DR. OTTO KAISER. (19 Plates; Haag; Martinus Nijhoff, 1891.) This important paper was written in response to a prize question proposed by the Society of Arts and Sciences of Utrecht.

This question called for the discussion of the Functions of the Ganglion Cells of the Cervical Spinal Cord, on the basis of an anatomical investigation, including also their arrangement, number, size and chemical characters at different periods of life in man, the monkey, the bat, the insectiveors and the rabbit.

The prize was awarded to the essay before us, which covers some eighty pages, and is accompanied by numerous plates and figures.

The facts set down in the introductory portion are historical.

In this, the various lines of evidence, showing, on the one hand, what groups of cells in the spinal cord give rise to nerve fibres innervating the arm; and, on the other, the portions of the arm to which these different nerve roots are distributed—are brought together; and the results are found to be fairly harmonious.

It is between the fourth cervical and the first thoracic segment, inclusive, that the centres lie; and in a general way, the more proximal portions of the limb are innervated by the centres lying most cephalad in the cord; whereas, the distal portions of the limb are innervated from lower lying centres.

Departing from this general outline, the author begins his own investigations with the study of the arrangement of the cells in man.

The cord was hardened in Müller's Fluid, cut into serial sections one-fiftieth of a millimetre in thickness, and stained with naphtylamin brown.

Not every section was preserved; but, according to the size of the animal, one section in every three, five, ten or twenty was retained.

Some of these were carefully drawn with the camera forming the plates; in others, the counting was carried on, and the number of cells in a given region estimated by multiplying the number of cells counted by the number of sections which had been cut.

The size of cells was measured, in length and breadth, and then their number determined according to groups into which they were classified.

According to the manner in which they took the stain, the cells were designated as chromophobic, or those which did not stain; and chromodectic or those which stained in a slight degree; and chromophilic or those which stained deeply.

The anatomical portion proper opens with a description of the grouping and number of these cells in man.

When this enumeration is thrown into the form of a curve, it is found that in passing down the cord from the third segment there is very rapid increase in cells which lie in the lateral portions of the grey anterior horn.

This occurs in man at different ages, and is present in all animals with which the human cord is here compared.

According to our author, the cell groups found in this region of the cord are not continued through the entire length of the cord, but are peculiar to this portion; and all the evidence goes to show that this group of cells, extending from the fourth cervical to the first thoracic segment, is to be associated with the muscles of the arm.

In no animal here examined are these cells so numerous as in man; they are, however, large, and not easily stained in such creatures as the mole and the bat, in which the motions of the forelimb are under less voluntary control. Indeed, here and throughout, it would appear, the cells most under voluntary control stain better, and are of smaller size, than the cells whose activity is more largely reflex.

With size, the author associates the increased capacity for discharging energy; whereas, with number he associates the increased refinement of coördination in the muscles controlled.

As regards the number of cells at different ages, his observations bring out some interesting facts concerning man.

In a male of thirty-six years, he finds approximately 250,000 cells in the ventral horn, from the fourth cervical to the first dorsal segment, inclusive.

When one compares this with the old account of Stilling, which gives but 300,000 ventral fibres in the entire cord, it is plain that either Stilling's account is far too low, or that there are present in the ventral horns a very large number of cells whose axis cylinder prolongations do not contribute to the ventral nerve roots, and it would seem that the former was the more probable explanation.

As regards the number of cells in the cervical region of man at different ages, his estimations give the following for the space between the fifth cervical segment, and the first dorsal segment, inclusive:

A fœtus at the beginning of the	5th month	shows	59,500	nerve cells.
" "	9th	"	118,330	"
A new-born child		"	104,270	"
A boy of fifteen years		"	211,800	"
An adult man of thirty-six years		"	221,206	"

There is here evident a very interesting increase in the number of nerve cells with the age of the individual, and although the fœtus of nine months possesses a few thousand more than the new-born child in this case, a certain amount of latitude must be given for individual variations.

The same argument might also apply to the difference noted between the boy of fifteen years and the man of thirty-six.

But, in general, there is a progressive increase which is sufficiently exemplified by comparing the figures for the fœtus at the beginning of the fifth month, those for a new-born child, and those for the boy of fifteen years.

It is, interesting, though perhaps not exactly just, to bring into comparison, with these results, those of Harting, published in 1845, in his "Recherches Micrométriques."

This author estimated the number of fibres in both the median and crural nerves, in both the new-born and adult male and female, and found in many instances that the number of nerve fibres in these nerves was the same in the new-born as in the adult; and also, a few years since, Schiller, working under the direction of Forel, determined the number of nerve fibres, in the oculo-motor nerve of the cat, at birth and at maturity, and found the numbers practically identical.

On the other hand, we know from the work of Birge, that the number of nerve fibres in the ventral roots, increases in the case of the frog, with the size, and therefore with the age of the individual.

The correctness of Harting's results may be fairly questioned, and we have then in the frog and man an increase in the number of nerve fibres after birth whereas, in the cat, judging from the condition in the oculo-motor nerve, the number of nerve fibres is fixed at birth.

Man, then, as compared with the cat, would have a nervous system which developed more slowly; and, as compared with the frog, it would appear that the development of nerve elements was more limited in the time of its occurrence.

The subject is certainly worth the most careful investigation, and is of the utmost importance from many standpoints, since it appears that the increase in the number of nerve cells, in later years, is due to the growth and expansion of the simple cells which are laid down early in the fœtal existence of the individual.

It is found that the chromophobic cells are larger than the chromophilic, and that both in man and the rabbit, which were alone examined, the size of the individual cells slowly increased with the age of the subject.

With regard to the grouping of the cells in the cervical region, the figures are necessary for a detailed criticism, and therefore we shall simply give the author's conclusions:

The cervical regions contain the following groups:

(*a*) The nucleus for the muscles of the back, which extends as a medial column through the entire length of the spinal cord.

(*b*) The nucleus of the accessory nerve, which lies on the lateral side of the nucleus just mentioned, and extends from the medulla oblongata into the sixth or seventh cervical segment.

(*c*) The nucleus of the phrenic nerve, which is placed between the two nuclei just mentioned, and extends from the third to the fifth or sixth cervical segment. Besides this, some fibres for the phrenic nerve are in the part derived from the medial portion of the dorsal cell groups.

(*d*) The nucleus for the upper extremity, which is located laterally, begins in the fourth or more rarely in the third segment, behind the nucleus for the accessory nerve, and reaches to the first or second dorsal segment.

The cephalic half may be divided into several groups, which innervate the muscles of the shoulder-girdle, the flexors and rotators of the forearm as well as of the radial muscles.

The cordal half may be divided into a ventral and dorsal portion. The former innervates the adductors of the upper arm, the pectoral muscle, the lattissimus, the teres major and the triceps. The latter, the flexors and extensors of the fingers, the ulnar muscles, and the small muscles of the hand.

On the Brain of the Late George Grote, F.R.S., with Comments and Observations on the Human Brain and its Parts Generally.

By the late Prof. John Marshall, LL.D., F.R.S., Professor of Surgery in University College, London; President of the General Medical Council. (Plates i., ii., iii., Journal of Anatomy and Physiology, Vol. xxvii., 1892.) At his own request, the brain of Mr. George Grote, the historian, was examined at his death.

The examination was made by Prof. John Marshall, and to the description of the brain itself the author adds a number of interesting general observations.

It is best, perhaps, at the outset, to say that this paper has two peculiarities: in the first place, it is a posthumous publication; and, in the second, we should say from internal evidence that the manuscript has been completed some fifteen or more years ago.

For these reasons it is not subject to the same sort of criticism that should meet a publication of the day.

Mr. Grote weighed about 165 pounds, was 5 feet 11½ inches in height, and died of renal disease at the age of seventy-five, in 1871.

It would appear that the brain had softened somewhat before the post-mortem examination.

The entire encephalon, with the pia mater, was found to weigh 1410 grammes, and about 21 grammes of fluid escaped upon the removal of the brain.

The subdivisions of the encephalon, viz., the cerebrum, cerebellum, pons and medulla, had the following weights:

Cerebrum,	1239	Grammes.
Cerebellum,	145	"
Pons and Medulla,	27	"